



Math Rocks: A Lesson in Asteroid Dynamics

On Feb. 15, 2013, a small asteroid entered Earth's atmosphere over Chelyabinsk, Russia, and startled onlookers with its fiery appearance and shockingly loud noise. NASA estimates the asteroid was approximately 17 meters in diameter with a mass of approximately 11,000 metric tons and traveled approximately 18 kilometers per second. Infrasound stations nearby and as far away as Antarctica and nearly half-way around the world detected the low-frequency sound waves generated by the meteor. The infrasound data indicates that the event, from atmospheric entry to the meteor's airborne disintegration took 32.5 seconds. The entry angle to horizontal was about 15° and the terminal part of the fireball was at about 20 km altitude.

- 1. What is the straight-line distance the meteor traveled through Earth's atmosphere?***

- 2. Compute the volume of the asteroid, assuming it was nearly spherical.***

- 3. Compute the density of the asteroid. What does this tell you about the physical composition of the asteroid? Is it primarily ice? Rock? Iron?***

- 4. How much energy was released by the event? Give answer in Joules and kilotons.***

- 5. At what altitude did atmospheric entry occur? What layer of the atmosphere is this?***